15. Tolerances and Surface Imperfections

Size tolerances and surface imperfections on O-rings are influenced by the tolerance, finish, and cleanliness of the mold cavities from which they are produced. These tolerances have been specified in the Aerospace Standard AS 568A and AS 871 A, DIN Standard 3771 Part 1, Part 4, and MIL-STD-413C.

The ERIKS O-rings are supplied to inspection level AQL 15 Level S4.
Size tolerances and surface imperfections are formed during production of O-rings by several causes:

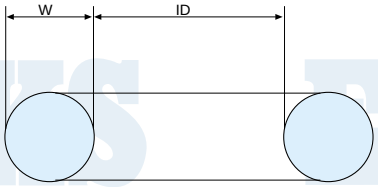
- inaccurate temperatures
- inclusion of air
- inaccurate installation of the mold
- inaccurate de-burring
- insufficient flow of the elastomer.

Typical limited defects in O-rings can be:

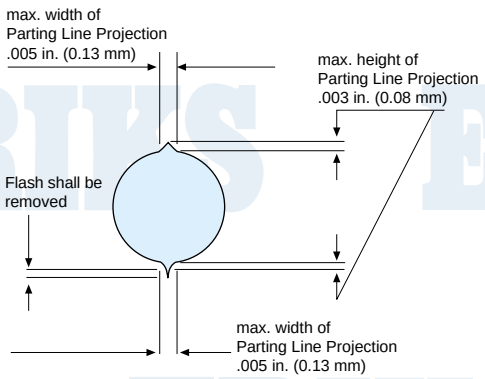
- *Dimensional Tolerance.*
  The finished dimensions for inner diameter and cross section of the O-ring shall conform to those quoted in the relevant standards. Variations in finished shape of section shall also be within the cross sectional tolerances specified in the relevant standards.

- *Parting Line Projection.*
  This projection, a continuous ridge of material situated on the parting line of the mold, caused by worn or otherwise excessively rounded mold edges shall not exceed .003 in. (0,08 mm) high or .005 in. (0,13 mm) wide. The parting line projection may extend beyond the maximum cross section diameter.

- *Flash.*
  A very thin gage, sometimes film-like material, which extends from the parting line projection, shall be removed.



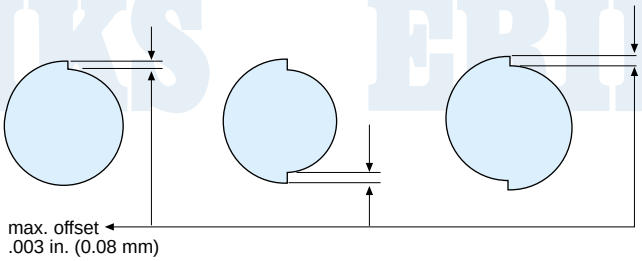
Dimensional tolerance



Maximum Permissible Parting Line Projection

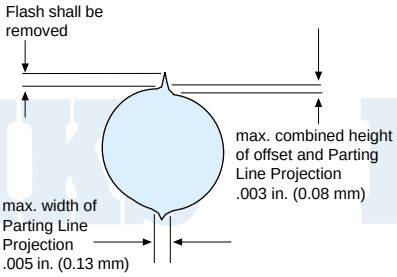
15. Tolerances and Surface Imperfections

- *Off Register and Mismatch (Offset).* Off register of the preformed O-ring resulting from the two halves of the mold cavities being out of line, and mismatch of the O-ring resulting from one half of the mold cavity being larger than the other shall not exceed .003 in. (0,08 mm) measured at the position of maximum offset on the molded O-ring. This shall not deviate from the nominal section of the ring in excess of the drawing tolerances.



Forms of off register and mismatch

- *Combined Molding Offset (Off Register and/or Mismatch) and Parting Line Projection.* The combination of parting line projection and offset, shall not exceed .003 in. (0,08 mm) high when measured at the position of maximum offset. It is permissible for this combined offset and parting line projection to extend beyond the maximum cross section diameter.



Combined offset (off register and/or mismatch) and parting line projection

Flats
Flats, resulting from the removal of flash on the inner and outer axial dimensions of an O-ring, shall not exceed a depth of .003 in. (0,08 mm) and shall not cause deviation from the nominal section of the O-ring in excess of the drawing tolerances, i.e. when the cross sectional diameter is on its lower limit no flatting is permissible. Non-continuous flats shall be blended out smoothly.

Backgrind
A torn or gouged condition (recess) occurring at the mold parting lines, caused by thermal expansion over a sharp mold edge or by premature cure.

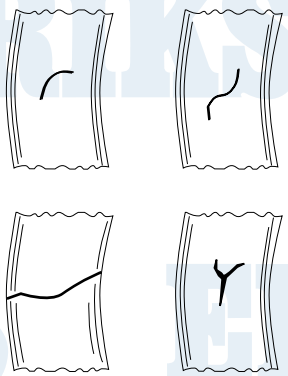
Parting line Indentation
A shallow saucer-like recess, sometimes triangular, located on the parting line OD or ID and may have random orientation. Caused by a deformity on the mold edge.

Inclusions and Indentations
Any extraneous embedded foreign matter is unacceptable. Depressions resulting from removal thereof must not exceed defined limits.

Non-Fill
An irregular flat spot or ribbon-like strip, generally having a coarser texture than the normal O-ring surface. Also a recessed wedge resembling a half-moon.

Mold Deposit Defects
Surface indentations, irregular in shape, and with rough surface texture are caused by a build up of hardened deposits in the mold cavity.

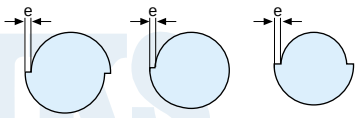
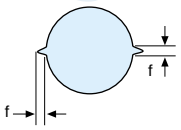
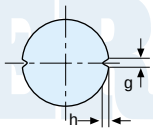
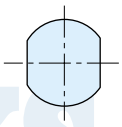
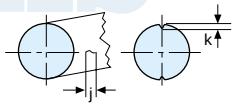
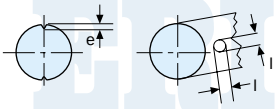
Flow Marks
A flow line, knit mark, or delamination, caused by poor knitting.



Example of Flow Marks

15. Tolerances and Surface Imperfections

Shape and Surface Deviations in O-ring Seals According to DIN 3771/4

Type of Deviation	*Schematic Representation*	*Measurement*	*Type Characteristics N d2 according to DIN 3771 part 1*				
			1,8	*2,65*	*3,55*	*5,3*	*7*
			Largest measure				
Shoulder and Shape Deformation		e	0,08	0,10	0,13	0,15	0,15
Bead, Ridge, and Shoulder combined		f	0,10	0,12	0,14	0,16	0,18
Grooving		g	0,18	0,27	0,36	0,53	0,70
		h	0,08	0,08	0,10	0,10	0,13
Ridge Removal Area		-	Departures from round cross-sections are permitted if the flat area transitions evenly into the curve, and d2 is maintained				
Flow lines (radial spread is not permissible)		j	1,5	1,5	0;05 d_1 or 1 6,5	6,5	6,5
		k			0,08		
Flow lines (radial spread is not permissible)		l	0,60	0,80	1,00	1,30	1,70
		depth m	0,08	0,08	0,10	0,10	0,13
Foreign Bodies	_	_	Not permitted				

1° According to which amount is the larger.
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All dimensions in mm.

15. Tolerances on cross section

Tolerances on cross section (W) for O-rings acc. AS 568AA.-inches

W	Tolerance	W	Tolerance	W	Tolerance
.070	+/- .003	.139	+/- .004	.275	+/- .006
.103	+/- .003	.210	+/- .005		

Tolerances on cross section (W) for O-rings acc. DIN 3771-millimeters

W	Tolerance	W	Tolerance	W	Tolerance	W	Tolerance
1,00	+/-0,08	3,00	+/-0,09	6,99	+/-0,15	14,00	+/-0,24
1,50	+/-0,08	3,50	+/-0,10 - 0,09	7,00	+/-0,15	15,00	+/-0,26
1,60	+/-0,08	3,53	+/-0,10	8,00	+/-0,18	16,00	+/-0,27
1,78	+/-0,08	3,60	+/-0,10	8,40	+/-0,18	18,00	+/-0,30
1,90	+/-0,08	4,00	+/-0,10	9,00	+/-0,20	20,00	+/-0,33
2,00	+/-0,08	4,50	+/-0,10	9,50	+/-0,20	24,00	+/-0,38
2,40	+/-0,08	5,00	+/-0,13 - 0,10	10,00	+/-0,20	25,00	+/-0,39
2,50	+/-0,08	5,33	+/-0,13	11,00	+/-0,20		
2,62	+/-0,08	5,70	+/-0,15	12,00	+/-0,22		
2,70	+/-0,09	6,00	+/-0,15	13,00	+/-0,23		

Tolerances on cross section (W) for O-rings - inches

W	Tolerance	W	Tolerance	W	Tolerance
.040	+/- .003	.118	+/- .003	.275	+/- .006
.059	+/- .003	.138	+/- .004	.315	+/- .007
.063	+/- .003	.139	+/- .004	.330	+/- .007
.070	+/- .003	.142	+/- .004	.354	+/- .008
.075	+/- .003	.157	+/- .004	.394	+/- .008
.079	+/- .003	.177	+/- .004	> .394	+/-1,8% to +/- .008
.095	+/- .003	.197	+/- .005		
.100	+/- .003	.210	+/- .005		
.103	+/- .003	.224	+/- .006		
.106	+/- .003	.236	+/- .006		

15. Tolerances on Inside Diameter for O-rings

Tolerances on Inside Diameter for O-rings acc. DIN 3771 - millimeters

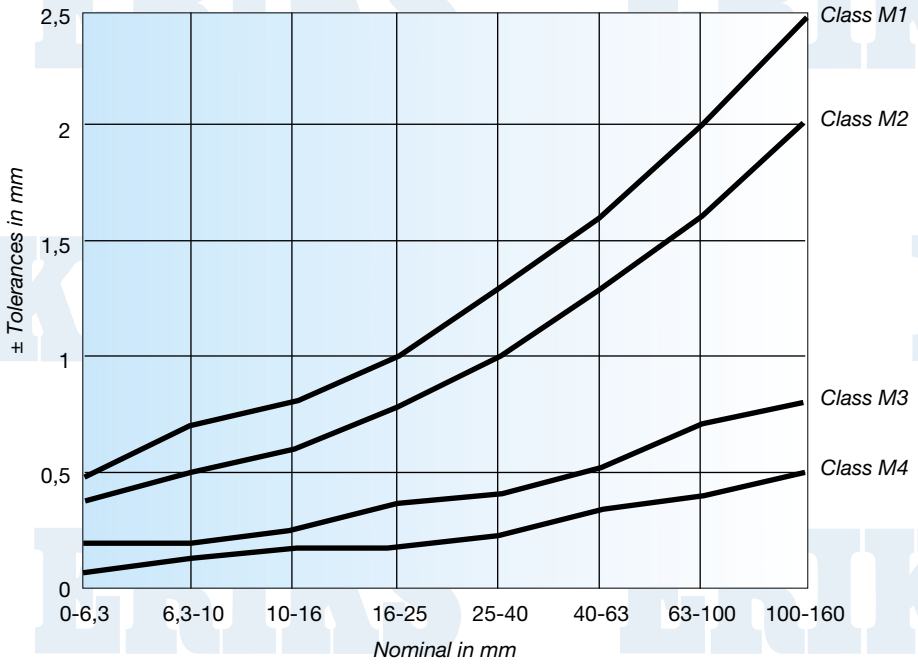
From	-	To	Tolerance
1,80	-	2,79	+/-0,13
2,80	-	4,86	+/-0,14
4,87	-	6,69	+/-0,15
6,70	-	8,75	+/-0,16
3,76	-	10,59	+/-0,17
10,60	-	11,79	+/-0,18
11,80	-	14,99	+/-0,19
15,00	-	16,99	+/-0,20
17,00	-	18,99	+/-0,21
19,00	-	21,19	+/-0,22
21,20	-	22,39	+/-0,23
22,40	-	24,99	+/-0,24
25,00	-	25,79	+/-0,25
25,80	-	27,99	+/-0,26
28,00	-	29,99	+/-0,28
30,00	-	31,49	+/-0,29
31,50	-	32,49	+/-0,31
32,50	-	34,49	+/-0,32
34,50	-	35,49	+/-0,33
35,50	-	36,49	+/-0,34
36,50	-	37,49	+/-0,35
37,50	-	38,69	+/-0,36
38,70	-	39,99	+/-0,37
40,00	-	41,19	+/-0,38
41,20	-	42,49	+/-0,39
42,50	-	43,69	+/-0,40
43,70	-	44,99	+/-0,41
45,00	-	46,19	+/-0,42
46,20	-	47,49	+/-0,43
47,50	-	48,69	+/-0,44
48,70	-	49,99	+/-0,45
50,00	-	51,49	+/-0,46
51,50	-	52,99	+/-0,47
53,00	-	54,49	+/-0,48
54,50	-	55,99	+/-0,50
56,00	-	57,99	+/-0,51
58,00	-	59,99	+/-0,52
60,00	-	61,49	+/-0,54
61,50	-	62,99	+/-0,55
63,00	-	64,99	+/-0,56
65,00	-	66,99	+/-0,58
67,00	-	68,99	+/-0,59
69,00	-	70,99	+/-0,61
71,00	-	72,99	+/-0,63
73,00	-	74,99	+/-0,64
75,00	-	77,49	+/-0,66
77,50	-	79,99	+/-0,67
80,00	-	82,49	+/-0,69
82,50	-	84,99	+/-0,71
85,00	-	87,49	+/-0,73
87,50	-	89,99	+/-0,75

From	-	To	Tolerance
90,00	-	92,49	+/-0,77
92,50	-	94,99	+/-0,79
95,00	-	97,49	+/-0,81
97,50	-	99,99	+/-0,83
100,00	-	102,90	+/-0,84
103,00	-	105,90	+/-0,87
106,00	-	108,90	+/-0,89
109,00	-	111,90	+/-0,91
112,00	-	114,90	+/-0,93
115,00	-	117,90	+/-0,95
118,00	-	121,90	+/-0,97
122,00	-	124,90	+/-1,00
125,00	-	127,90	+/-1,03
128,00	-	131,90	+/-1,05
132,00	-	135,90	+/-1,08
136,00	-	139,90	+/-1,10
140,00	-	144,90	+/-1,13
145,00	-	149,90	+/-1,17
150,00	-	154,90	+/-1,20
155,00	-	159,90	+/-1,24
160,00	-	164,90	+/-1,27
165,00	-	169,90	+/-1,31
170,00	-	174,90	+/-1,34
175,00	-	179,90	+/-1,38
180,00	-	184,90	+/-1,94
185,00	-	189,90	+/-1,44
190,00	-	194,90	+/-1,48
195,00	-	199,90	+/-1,51
200,00	-	205,90	+/-1,55
206,00	-	211,90	+/-1,59
212,00	-	217,90	+/-1,63
218,00	-	223,90	+/-1,67
224,00	-	229,90	+/-1,71
230,00	-	235,90	+/-1,75
236,00	-	242,90	+/-1,79
243,00	-	249,90	+/-1,83
250,00	-	257,90	+/-1,88
258,00	-	264,90	+/-1,93
265,00	-	271,90	+/-1,98
272,00	-	279,90	+/-2,02
280,00	-	289,90	+/-2,08
290,00	-	299,90	+/-2,14
300,00	-	306,90	+/-2,21
307,00	-	314,90	+/-2,25
315,00	-	324,90	+/-2,30
325,00	-	334,90	+/-2,37
335,00	-	344,90	+/-2,43
345,00	-	354,90	+/-2,49
355,00	-	364,90	+/-2,56
365,00	-	374,90	+/-2,62
375,00	-	386,90	+/-2,68

From	-	To	Tolerance
387,00	-	399,90	+/-2,76
400,00	-	411,90	+/-2,84
412,00	-	424,90	+/-2,91
425,00	-	436,90	+/-2,99
437,00	-	449,90	+/-3,07
450,00	-	461,90	+/-3,15
462,00	-	474,90	+/-3,22
475,00	-	486,90	+/-3,30
487,00	-	499,90	+/-3,37
500,00	-	514,90	+/-3,45
515,00	-	529,90	+/-3,54
530,00	-	544,90	+/-3,63
545,00	-	559,90	+/-3,72
560,00	-	579,90	+/-3,81
580,00	-	599,90	+/-3,93
600,00	-	614,90	+/-4,05
615,00	-	629,90	+/-4,13
630,00	-	649,90	+/-4,22
650,00	-	669,90	+/-4,34
670,00	-	679,90	+/-4,46
680,00	-	689,90	+/-4,52
690,00	-	699,90	+/-4,57
700,00	-	709,90	+/-4,63
710,00	-	719,90	+/-4,68
720,00	-	729,90	+/-4,74
730,00	-	739,90	+/-4,79
740,00	-	749,90	+/-4,84
750,00	-	759,90	+/-4,90
760,00	-	769,90	+/-4,95
770,00	-	779,90	+/-5,00
780,00	-	789,90	+/-5,06
790,00	-	799,90	+/-5,11
800,00	-	809,90	+/-5,16
810,00	-	819,90	+/-5,21
820,00	-	829,90	+/-5,16
830,00	-	839,90	+/-5,32
840,00	-	849,90	+/-5,37
850,00	-	859,90	+/-5,42
860,00	-	869,90	+/-5,47
870,00	-	879,90	+/-5,52
880,00	-	889,90	+/-5,57
890,00	-	899,90	+/-5,62
900,00	-	909,90	+/-5,67
910,00	-	919,90	+/-5,72
920,00	-	929,90	+/-5,77
930,00	-	939,90	+/-5,82
940,00	-	949,90	+/-5,87
950,00	-	959,90	+/-5,91
960,00	-	969,90	+/-5,96
970,00	-	979,90	+/-6,01
980,00	-	989,90	+/-6,06

15. Tolerances on Inside Diameter for O-rings

Note:
The tolerances on O-rings are different from those for molded parts.
Molded parts tolerances are according to DIN ISO 3302-1 and have different classes, depending on the application.
The following chart indicates these classes.



This chart indicates the tolerances for moulded rubber parts.

Optical surface measurements
Due to modern Basler machines ERIKS can control tolerances and surface imperfections to many different international standards. These machines are able to control O-rings up to 30 mm outside diameter.
Ask the local ERIKS representative for more information.

Principle: